#### THE *LOPHOCOLEUS* GROUP OF GENERA (LEPIDOPTERA: EREBIDAE: HERMINIINAE) IN FIJI, WITH THE DESCRIPTION OF A NEW GENUS AND SPECIES

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### Abstract

Three related endemic moth genera from Fiji: *Lophocoleus* Butler, *Tholocoleus* Robinson and *Palaeocoleus* Robinson, are reviewed and descriptions and illustrations of the females and their genitalia are provided. An additional new genus and species, *Archaeocoleus namosii* gen. n. & sp. n., is described and illustrated from both sexes.

### Introduction

The endemic erebid moth genus *Lophocoleus* Butler is of particular interest as it shows considerable radiation in Fiji. It was described by Butler (1886), who included only his new species *L. mirabilis* Butler. Robinson (1975) described five further new species in the genus, illustrated the males and provided a guide to their identification based on the male genitalia. Robinson (1975) also introduced two new monotypic genera: *Tholocoleus* Robinson, to which he assigned the endemic species described by Butler (1886) as *Lophocoleus? astrifer* Butler; and *Palaeocoleus* Robinson, to which he assigned the endemic species described by Butler (1886) as *Bocana sypnoides* Butler.

Robinson's (1975) descriptions of these eight species are completed here by illustrations and descriptions of the females, including their internal genitalia. Significant differences in the female genitalia provide a reliable guide to the separation of the species, which supports Robinson's classification based on the male genitalia.

A previously undescribed species was discovered that can be assigned to this group of genera. It does not precisely agree with the diagnosis of any of the three presently recognised genera and differs in several characteristics from the species currently assigned to them. The species appears, at least superficially, to be most closely related to *Lophocoleus*, but it differs from it sufficiently that a new genus, *Archaeocoleus*, is erected to accommodate it. The new species is described here as *Archaeocoleus namosii*.

### Materials and methods

A regular programme of light trapping was carried out during the period 1991-1998. This was used to sample the moth fauna at various forest locations in eastern Viti Levu, Fiji. The locations ranged in altitude from sea level to 900 m. A battery powered trap was employed, using a 6W actinic tube as light source. This allowed easier access to more remote locations. A small number of further visits were made up to 2013.

The collection resulting from this work has been studied and has resulted in a series of papers including the descriptions of a number of new taxa (Clayton 2002, 2008, 2010, 2011). The current paper is the latest in this series.

### **Systematics**

The classification followed here is that of Zahari *et al.* (2012), which has superseded that of Kitching and Rawlins (1999). This treats the Herminiinae as a subfamily of the Erebidae rather than of the Noctuidae.

# Family Erebidae Subfamily Herminiinae Genus *Lophocoleus* Butler, 1886

Butler (1886) erected this genus on the basis of the bipectinate male antennae and the modified male foreleg. The first tarsal segment is enormously elongated and a tibial sheath extends almost to the end of this first segment. Robinson (1975) extended this diagnosis by including characters of the male genitalia. The valves are broad and truncated apically and a variety of dorsal and ventral apical processes are diagnostic at species level; in the aedeagus, the vesica bears a striking group of heavily sclerotised cornuti, the precise arrangement and form of these structures again being diagnostic at species level. Robinson (1975) described five new species to add to Butler's *L. mirabilis*; he also described the males of all six species, which he illustrated together with the valves and the groups of cornuti.

The forewings vary from generally blackish brown to a brighter orangebrown, with a variety of generally somewhat obscure markings. The contrasting hind wings are generally pale greyish or greyish brown with some darker shading towards the termen; there is no sexual dimorphism in colouration or markings. The females do, however, have unmodified forelegs and filiform antennae. Somewhat unusually, the females are consistently smaller than the males.

In the female genitalia, the sterigma and ductus show little structure with only light sclerotisation and provide no diagnostic features. However, the bursa copulatrix is quite striking and provides excellent features for diagnosis to species level. The shape varies and there are generally one or two strongly sclerotised areas, plus an area containing a large number of small, star-shaped denticles which comprise the signa.

### Lophocoleus mirabilis Butler, 1886

### (Figs 1, 9)

*Diagnosis.* Forewings mid-brown with only very faint darker basal and postmedial lines; a prominent whitish reniform stigma is diagnostic, not being present in any other *Lophocoleus* species.



**Figs 1-8.** Lophocoleus group females. (1) Lophocoleus mirabilis; (2) L. suffusa; (3) L. albipuncta; (4) L. iridescens; (5) L. acuta; (6) L. rubrescens; (7) Tholocoleus astrifer; (8) Palaeocoleus sypnoides.



**Figs 9-16.** Lophocoleus group: bursa copulatrix of females. (9) Lophocoleus mirabilis; (10) L. suffusa; (11) L. albipuncta; (12) L. iridescens; (13) L. acuta; (14) L. rubrescens; (15) Tholocoleus astrifer (including ductus); (16) Palaeocoleus sypnoides.

Male. Described by Robinson (1975: 232, plate fig. 177, text figs 95, 101).

*Female* (Fig. 1). Wingspan 38 mm. Patterned as male. Genitalia with bursa copulatrix (Fig. 9) generally rounded, twice as long as broad; signa a band of many small star-shaped denticles around apical third, but leaving tip unmarked; several diffuse areas of scobination.

*Occurrence*. Only a single female was taken, in primary rainforest on the main island, Viti Levu, close to Suva. Robinson also found this species to be very scarce, despite it being the only *Lophocoleus* taken by Butler.

### Lophocoleus suffusa Robinson, 1975

(Figs 2, 10)

*Diagnosis*. Forewings plain mid-brown with only very faint darker basal, postmedial and subterminal lines.

Male. Described by Robinson (1975: 233, plate fig. 188, text figs 97, 103).

*Female* (Fig. 2). Wingspan 35-38 mm. Patterned as male. Genitalia with bursa copulatrix (Fig. 10) generally rounded, one and a half times as long as broad; signa a circular area of small star-shaped denticles in apical half; a slightly smaller circular dark area present in the basal half; the remainder covered in light scobination.

*Occurrence*. Small numbers taken in various rainforest locations in eastern Viti Levu, from low levels to 1000 m.

#### Lophocoleus albipuncta Robinson, 1975

(Figs 3, 11)

*Diagnosis.* Forewings mid to dark brown; basal and postmedial lines more clearly defined than in *L. suffusa;* subterminal line white; sharply dentate between M1 and M2 leaving a clear, detached white V-shaped mark. Some specimens show a suggestion of blue iridescence in the pale markings and could be confused with worn specimens of *L. iridescens*, but this lacks the V-shaped mark, having the subterminal line continuous between M1 and M2.

Male. Described by Robinson (1975: 231, plate fig. 186, text figs 98, 104).

*Female* (Fig. 3). Wingspan 35-40 mm. Patterned as male. Genitalia with bursa copulatrix (Fig. 11) approximately as long as broad, with a prominent lateral appendix; signa an area of small star-shaped denticles opposite appendix; various degrees of scobination over most of the surface, somewhat darker around the base of the extension.

*Occurrence.* The most numerous of the six *Lophocoleus* species, taken in various rainforest locations in eastern Viti Levu.

### Lophocoleus iridescens Robinson, 1975

## (Figs 4, 12)

*Diagnosis.* Forewings dark brown, with darker basal and medial lines and pale subterminal line. Fresh specimens of *L. iridescens* are unmistakable due to areas of bright blue iridescence around the basal and medial lines; subterminal line also iridescent blue. Worn specimens lose the blue iridescence and superficially could be mistaken for *L. albipuncta* (q.v.).

Male. Described by Robinson (1975: 231, plate fig. 183, text figs 93, 96, 102).

*Female* (Fig. 4). Wingspan 35-39 mm. Patterned as male. Genitalia with bursa copulatrix (Fig. 12) three times as long as broad; signa an area of small star-shaped denticles on one side, from midpoint to apex; a dark sclerotised area basally opposite signa; remainder with various degrees of scobination.

*Occurrence*. Small numbers taken in various rainforest locations in eastern Viti Levu, from 200 m to 900 m.

### Lophocoleus acuta Robinson, 1975

### (Figs 5, 13)

*Diagnosis*. One of three species under consideration with a markedly concave forewing termen. The bright orange-brown colouration and markings are diagnostic and show little variation.

Male. Described by Robinson (1975: 230, plate fig. 184, text figs 100, 106).

*Female* (Fig. 5). Wingspan 27-32 mm. Patterned as male. Genitalia with bursa copulatrix (Fig. 13) generally rounded, one and a half times as long as broad; signa a circular area of small star-shaped denticles apically; a sclerotised diagonal band at basal one third; between this band and the signa, an area of light scobination with an ordered array of pale, star-shaped markings, appearing like the inverse of the dark star-shaped teeth of the signa.

*Occurrence*. Small numbers taken in various rainforest locations in eastern Viti Levu, from low levels to 1000 m

### Lophocoleus rubrescens Robinson, 1975

### (Figs 6, 14)

*Diagnosis.* One of three species under consideration with a markedly concave forewing termen. The dull orange-bronze colouration and markings, together with the orbicular stigma consisting of three dark brown dots, are diagnostic.

Male. Described by Robinson (1975: 232, plate fig. 189, text figs 99, 105).

*Female* (Fig. 6). Wingspan 33-34 mm. Patterned as male. Genitalia with bursa copulatrix (Fig. 14) generally rounded, a little longer than broad; signa a circular area of small star-shaped denticles covering apical third; this area larger, and the denticles individually larger, than in other *Lophocoleus* species; this area also bulging somewhat from the main shape of the bursa copulatrix; remainder covered by light scobination; no other sclerotised areas or significant markings.

*Occurrence.* Small numbers taken in various rainforest locations in eastern Viti Levu, from 200 m to 1000 m.

#### Archaeocoleus gen. n.

Type species Archaeocoleus namosii sp. n., by present designation.

Possesses many of the characters of *Lophocoleus* Butler but lacks the modification of the male foreleg. In addition, the valves of the male genitalia lack a truncate apex and apical processes and the bursa copulatrix of the female genitalia lacks a signa.

### Archaeocoleus namosii sp. n.

### (Figs 17-21)

*Types. Holotype*  $\Im$ , FIJI: Viti Levu, Namosi Highlands, grid ref. N29/4075, 31.i.98, at light, J.A. Clayton. *Paratypes:* 2  $\Im$  $\Im$ , same data as holotype except 26.ii.97 and 25.i.98; 2  $\Im$  $\Im$ , same data as holotype except 17.vi.95 and 14.ix.96. All types and genitalia slides have been deposited in the National Museums of Scotland, Edinburgh.

*Description.* Male (Fig. 17): Wingspan 19-23 mm. Head and antennae buff. Thorax light brown. Abdomen buff. Antennae bipectinate. Labial palps upturned, short, reaching level of eyes; first two segments bearing long scales; short third segment less heavily scaled. Forewings broadly triangular; costa largely straight, slightly bowed towards apex.; apex obtuse; termen convex; yellowish buff more or less irrorated with dark brown; irroration heavier in basal half of wing; a terminal series of five whitish streaks extending from apex; reniform stigma a pale figure-of-eight shape filled with buff; orbicular stigma a small dark brown spot; the area between the stigmata shaded dark brown; a dark brown patch between reniform stigma and dorsum. Hind wings uniform pale buff.

The genitalia are shown in Fig. 19. Valves simple and narrow, about eight times as long as broad; uncus mainly straight and of equal width throughout; a downcurved spine at the tip; aedeagus (fig. 20) with a prominent group of six curved, heavily sclerotised cornuti.

Female (Fig. 18): Wingspan 27-33 mm. Antennae bipectinate. Similarly patterned to the male. Forewings less yellowish than the male; brown markings darker. Hind wings more greyish brown and somewhat darker than the male.



**Figs 17-21.** *Archaeocoleus namosii* sp. n. (17) male holotype; (18) female paratype; (19) genitalia of male holotype; (20) aedeagus of male holotype; (21) genitalia of female paratype.

The genitalia are shown in Fig. 21. Sterigma and ductus showing no features of diagnostic value; bursa copulatrix as long as broad; a sclerotised basal area considerably folded; otherwise without any ornamentation or areas of scobination.

The association between the males and females of this species is based on the detailed similarities in the markings, supported by being taken at the same location.

*Etymology.* The name *namosii* is derived from the fact that the type series was collected entirely in Namosi Province. The generic name *Archaeocoleus* suggests that it might represent a more primitive branch than *Lophocoleus* itself.

Distribution. Rainforest at a height of 200 m on Viti Levu.

*Taxonomy*. Some confusion was experienced in placing this species. Robinson (1975: 136) described a species, which he labelled as an 'Indeterminate species (Acronictinae)', known only from two males. One of the two specimens was in good condition, but missing the abdomen. He illustrated this in his plate fig. 340. The other was complete but in poor condition and he illustrated the genitalia and aedeagus of this, along with the fore and hind wing venation and antennae (his text figs 74-77). The male genitalia, aedeagus, wing venation and antennae of the current species agree with those illustrated by Robinson (1975). His description of the fore and hind wings and his illustration also agree. It is almost certain that the current species and that described by Robinson are the same.

Robinson (1975) gave no explanation as to why this species should be placed in the Acronictinae and indeed it is difficult to see why this should be so. Although he treated both the Herminiinae and the Acronictinae as part of the Noctuidae, the subfamilies are not closely related and bear little similarity. It is most likely that the placement was a simple error on Robinson's part. Zahari *et al.* (2012) did not recognise the Acronictinae as part of the Erebidae and it remains as part of the Noctuidae. The present species differs in lacking the characteristic colouration and facies of this subfamily, the forewing shape differs markedly and the body is more slender. The male genitalia have little in common with acronictine species and its overall appearance suggests placement in the Herminiinae. Although there is no accepted precise definition of this subfamily, it has traditionally been defined as being composed of quadrifine 'noctuids' with a pre-spiracular counter-tympanal hood. These features are present in the current species, so it is here placed in the Herminiinae.

Holloway (2008) discussed the Herminiinae genera in the Bornean context. Based on his classification, *A. namosii* cannot be placed in any of his genera. Apart from the three endemic genera in the *Lophocoleus* group discussed here, other Fijian Herminiinae genera are included in Holloway's discussion and are therefore excluded as possible candidates. *Archaeocoleus namosii* does not show all the characteristic features of any of the three genera in this group.

The wing shape and general appearance would place it in *Lophocoleus*. This is supported by the striking group of cornuti in the aedeagus. This is a feature not found in any other Herminiinae genus (or indeed consistently in any other erebid genera) described by Robinson or Holloway. However, in the male genitalia the valves lack the truncated apex and apical processes and in the female the bursa copulatrix lacks signa. Also, the male of *A. namosii* lacks the modified foreleg of *Lophocoleus* species. For these reasons, a new genus, *Archaeocoleus*, is proposed.

*Remarks.* Of the other species in the group, *A. namosii* most resembles *L, albipuncta* in general appearance. However, in addition to the differences summarised in the description of the genus *Archaeocoleus, A. namosii* lacks a distinct subterminal line in the forewings, which serves to separate it from *L. albipuncta* and other *Lophocoleus* species.

## Genus Tholocoleus Robinson, 1975

Robinson (1975) described this genus as being allied to *Lophocoleus*. The forewing termen is concave in the apical half, similar to *L. acuta*. The terminal segment of the male palp is greatly expanded and the male antennae filiform. The male foreleg is modified, similar to *Lophocoleus*. In the male genitalia the valves are rounded apically and the aedeagus has a group of terminal, thorn-like carinae but is lacking cornuti.

*Tholocoleus* differs from *Lophocoleus* in having the hind wings and forewings similarly coloured and marked. The males and females are of similar size and there is no sexual dimorphism in terms of colouration or markings. The female genitalia show no significant structure in the sterigma, but there is a sclerotised section in the ductus; the bursa copulatrix lacks the small, star-shaped denticles characteristic of the signa of *Lophocoleus*.

## Tholocoleus astrifer (Butler, 1886)

(Figs 7, 15)

Diagnosis. The palp length, wing shape and pattern are diagnostic.

Male. Described by Robinson (1975: 238, plate fig. 176, text figs 94, 107, 109).

*Female* (Fig. 7). Wingspan 44-48 mm. Patterned as male. Antennae filiform and foreleg unmodified. Genitalia (Fig. 15) with sclerotised section towards basal end of ductus; bursa copulatrix generally rounded, a little longer than broad; two longitudinal signa running over half the length of bursa copulatrix; remainder covered by light scobination; no other sclerotised areas or significant structures.

*Occurrence*. Small numbers taken in various rainforest locations in eastern Viti Levu, from 500 m to 1000 m.

### Genus Palaeocoleus Robinson, 1975

Robinson (1975) described this genus as being allied to *Lophocoleus*. It has a more mottled appearance and more rounded wings. The terminal segment of the male palp is twice that of *Lophocoleus* but smaller than in *Tholocoleus*. Male antennae bipectinate, but with segments one to five filiform and six to nine unipectinate. Modified male foreleg similar to *Lophocoleus* and *Tholocoleus*. Male genitalia with valves truncated and with apical processes, similar to *Lophocoleus*; aedeagus plain; vesica with fine scobination only.

*Palaeocoleus* is intermediate between *Lophocoleus* and *Tholocoleus* in appearance in having the hind wings somewhat paler than the forewings, but reflecting their markings. As in *Lophocoleus*, the females are consistently smaller than the males. The female genitalia show no significant structure in the sterigma or ductus; the bursa copulatrix is somewhat irregularly shaped, but with no significant markings.

### Palaeocoleus sypnoides (Butler, 1886)

(Figs 8, 16)

Diagnosis. The more rounded wing shape and pattern are diagnostic.

Male. Described by Robinson (1975: 235, plate fig. 1764 text figs 108, 110).

*Female* (Fig. 8). Wingspan 32-37 mm. Patterned as male. Antennae filiform and foreleg unmodified. Genitalia (Fig. 16) with bursa copulatrix very lightly marked and flimsy in nature, approximately twice as long as broad, somewhat irregular in shape; a narrow subbasal appendix; some areas of very light scobination; no signa or other significant structures.

*Occurrence*. Good numbers taken in various rainforest locations in eastern Viti Levu and Vanua Levu from lower levels to 500 m, but not taken in more montane forest locations. After *L. albipuncta*, this is the commonest species in the group.

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